EXHIBIT 1

K-1688

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of: Yeckley	)
	) GROUP ART UNIT 1755
Serial No. 09/724,188	)
Filed: November 28, 2000	) Examiner: Group, Karl
For: **SiAlON Containing Ytterbium**	)
And Method of Making	)

DECLARATION OF RUSSELL L. YECKLEY

I, Russell L. Yeckley, hereby declare as follows that:

1. I am over the age of twenty-one (21) years and am a citizen of the United States of America and a resident of the Commonwealth of Pennsylvania.

2. I am the inventor of the above-captioned pending U.S. Patent Application, that I am an employee of Kennametal Inc., the assignee of the above-captioned patent application, and that I am making this Declaration on behalf of Kennametal Inc.

3. My post-high school educational background is as follows: in 1976 I received a B.S. in Ceramic Engineering from Penn State University and in 1984 I received a M.S. in Materials Engineering from the University of Pittsburgh.

4. Since 1979 I have been employed in various positions pertaining to the development and/or production of ceramic materials such as SiAlON materials and silicon nitride materials.

5. Under my direction I had performed some experiments wherein the compositions of the starting powder mixtures and the properties of the resultant SiAlON ceramics are set forth in Table 1 below.

Table 1. Composition and Properties of Sialon ab83612

	Composition in Weight Percent											
	Si3N4	Si3N4	AlN Starck grade	Al2O3	Yb2O3	β Si3N4 Weight Percent	Hvn		Kic		α sialon	Yb4SiAlO8N
Batch	Starck M11	Ube SNE-03	A	Ceralox HPA-0.5	Molycorp		GPa	st dev	MPa m1/2	st dev	Weight percent	R.I.
1924C	21.70%	65.10%	4.5	2.5	6.2	2.0	18.24	0.29	7.05	0.12	31.5	3.3
1924D		86.80%	4.5	2.5	6.2	0	18.06	0.47	7.24	0.10	41.7	2.1
1924E	43.40%	43.40%	4.5	2.5	6.2	4.o	18.30	0.22	6.65	0.12	23.3	3.6

Table 1 reports:

(A) the starting compositions, selected physical properties, and selected phases present for Batch Nos. 1924C, 1924D and 1924E;

(B) for each of the batches the starting powder components in weight percent wherein the components comprise Stark M11 silicon nitride powder (which has 8weight percent beta silicon nitride), Ube SNE-03 silicon nitride powder (which has 0 weight percent beta silicon nitride), Stark Grade A aluminum nitride powder, Ceralox HPA-05 aluminum oxide powder, and Molycorp ytterbium oxide powder;

(C) for each of the batches the beta silicon nitride content (weight percent) in the starting silicon nitride powder;

(D) for each of the batches the Vickers hardness (18.5 kg load) reported in GPa (along with the standard deviation);

(E) for each of the batches the fracture toughness (K_{IC}) determined by the Evans and Charles technique and reported in MPa•m ½ (along with the standard deviation);

(F) for each of the batches the content of the alpha prime SiAlON phase in weight percent of the total of the alpha prime SiAlON phase and the beta prime SiAlON phase; and

(G) for each of the batches the relative intensity of the crystalline intergranular phase Yb_4SiAlO_8N.

6. The powder mixtures as set forth in Table 1 were processed as follows: the compacts were belt-sintered in one atmosphere of flowing nitrogen for 30 minutes in each one of the following temperature zones: 1550 °C, 1700 °C, 1765 °C, and 1765°C, and then hot isostatically pressed at a maximum temperature of 1830 °C for 30 minutes under a pressure of 20,000 pounds per square inch.

7. Figures 1 and 2 attached hereto (Exhibit A) comprise backscatter scanning electron microscope (SEM) photomicrographs (with a 40 micrometer legend) of the polished surface wherein these two photomicrographs compare the resulting microstructure of Batch Nos. 1924E and 1924D respectively. In Figures 1 and 2 the brightest phase is the ytterbia aluminum silicon oxy-nitride grain boundary phase, the medium gray grains are the alpha prime SiAlON phase, and the darkest grains are the beta prime SiAlON phase.

8. A comparison of the microstructure as illustrated in Figures 1 and 2 against the x-ray diffraction results in Table 1 shows that there is a consistency between the microstructure and the x-ray diffraction results in that more alpha prime SiAlON phase is present in Batch No. 1924D as compared to Batch No. 1924E even through the starting powder compositions for Batch Nos. 1924 D and 1924E are the same, except for the beta silicon nitride content.

9. A comparison of the microstructure as illustrated in Figures 1 and 2 against the x-ray diffraction results in table 1 shows that the beta prime SiAlON grains in Batch No. 1924D achieve a greater aspect ratio (length/width) so as to be more elongate than the beta prime SiAlON grains in Batch No. 1924E even though the starting powder compositions are the same, except for the beta silicon nitride content. The more elongate beta prime SiAlON grains in Batch No. 1924D is consistent with the greater fracture toughness as compared to Batch No. 1924E.

10. Under my direction I had performed some experiments wherein the compositions of the starting powder mixtures and the properties of the resultant SiAlON ceramics are set forth in Table 2 below.

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K-1688

In the application of: Yeckley
Serial No. 09/724,188
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DECLARATION OF RUSSELL L. YECKLEY

Table 2 Composition and Properties of Sialon ab74012

	Composition in Weight Percent													
	Si3N4	Si3N4	Si3N4	AlN	Al2O3	Yb2O3	β Si3N4	Hvn		Kic		α sialon	YbAlO3	Yb4SiAlO8N
Batch	Starck M11	Ube SNE-03	Ube SNE-10	Starck grade A	Ceralox HPA-0.5	Molycorp	Weight Percent	GPa	st dev	MPa m1/2	st dev	Weight percent	R.I.	R.I.
1860A	43.85%	43.85%		3.5	2.6	6.2	4.0	16.53	0.30	6.81	0.23	7.4		3.4
1860B	65.78%	21.93%		3.5	2.6	6.2	6.0	16.00	0.26	6.66	0.09	0	4.3	6.9
1860C	87.70%			3.5	2.6	6.2	8	16.26	0.21	6.53	0.16	0	4.7	3.5
1914B			87.70%	3.5	2.6	6.2	2	16.53	0.26	6.45	0.19	4.5		2.9
1914A		87.70%		3.5	2.6	6.2	0	17.62	0.34	7.08	0.23	29.2		3.7

Table 2 reports:

(A) the starting compositions, selected physical properties, and selected phases present in Batch Nos. 1860A, 1860B, 1860C, 1914B and 1914A;

(B) for each of the batches the starting powder components in weight percent wherein the components comprise Stark M11 silicon nitride powder (which has 8 weight percent beta silicon nitride), Ube SNE-10 silicon nitride powder (which has 2 weight percent beta silicon nitride), Ube SNE-03 silicon nitride powder (which has 0 weight percent beta silicon nitride), Stark Grade A aluminum nitride powder, Ceralox HPA-05 aluminum oxide powder, and Molycorp ytterbium oxide powder;

(C) for each of the batches the beta silicon nitride content (weight percent) in the starting silicon nitride powder;

(D) for each of the batches the Vickers hardness (18.5 kg load) reported in GPa (along with the standard deviation);

(E) for each of the batches the fracture toughness (K_{IC}) determined by the Evans and Charles technique and reported in MPa•m$^{1/2}$ (along with the standard deviation);

(F) for each of the batches the content of the alpha prime SiAlON phase in weight percent of the total of the alpha prime SiAlON phase and the beta prime SiAlON phase;

(G) for each of the batches the relative intensity of the crystalline intergranular phase Yb_4SiAlO_8N; and

(H) for each of the batches the relative intensity of the crystalline intergranular phase $YbAlO_3$.

11. The powder mixtures as set forth in Table 1 were processed as set out in Paragraph 6 hereof.

12. Figures 3 and 4 attached hereto (Exhibit B) comprise backscatter scanning electron microscope (SEM) photographs (with a 40 micrometer legend) of the polished surface wherein these photomicrographs compare the resulting microstructures of Batch Nos. 1860C and 1914A, respectively. In Figures 3 and 4 the brightest phase is the ytterbia aluminum silicon oxy-nitride grain boundary phase, the medium gray grains are the alpha prime SiAlON phase, and the darkest grains are the beta prime SiAlON phase.

13. A comparison of the microstructure as illustrated in Figures 3 and 4 against the x-ray diffraction results in Table 2 shows that there is a consistency between the microstructure and the diffraction results in that more alpha prime SiAlON phase is present in Batch No. 1914A as compared to Batch No. 1860C (which has no alpha prime SiAlON phase) even through the starting powder compositions for Batch Nos. 1860C and 1914A are the same, except for the beta silicon nitride content.

14. A comparison of the microstructure as illustrated in Figures 3 and 4 against the x-ray diffraction results show that the beta prime SiAlON grains in Batch No. 1914A achieve a greater aspect ratio (length/width) so as to be more elongate than the beta prime SiAlON grains in Batch No. 1860C even though the starting powder compositions are the same, except for the beta silicon nitride content. The more elongate beta prime SiAlON

grains in Batch No. 1914A are consistent with the greater fracture toughness as compared to Batch No. 1860C.

15. Under my direction I had performed some experiments wherein the compositions of the starting powder mixtures and the properties of the resultant SiAlON ceramics are set forth in Table 3 below.

Table 3. Composition and Properties of Sialon ab153216.

Batch	Composition in Weight Percent Si3N4 Starck M11	Si3N4 Ube SNE-03	Si3N4 Ube SNE-10	AlN Starck grade A	Al2O3 Ceralox HPA-0.5	Yb2O3 Molycorp	β Si3N4 Weight percent	Hvn GPa	st dev	Kic MPa m1/2	st dev	α-sialon Weight percent
1417A		77.90%		7.60%	6.30%	8.20%	0	19.69	0.16	6.40	0.15	59.9
1703B	37.96%	37.95%		8.20%	7.70%	8.20%	4.0	17.31	0.62	5.32	0.42	23.7
1605C		56.93%	18.98%	8.20%	7.70%	8.20%	0.5	19.04	0.39	6.43	0.35	50.8

Table 3 reports:

(A) the starting compositions, selected physical properties, and selected phases present for Batch Nos. 1417A, 1703B and 1605C;

(B) for each of the batches the starting powder components in weight percent wherein the components comprise Stark M11 silicon nitride powder (which has 8 weight percent beta silicon nitride), Ube SNE-03 silicon nitride powder (which has 0 weight percent beta silicon nitride), Ube SNE-10 silicon nitride powder (which has 2 weight percent beta silicon nitride), Stark Grade A aluminum nitride powder, Ceralox HPA-05 aluminum oxide powder, and Molycorp ytterbium oxide powder;

(C) for each of the batches the beta silicon nitride content (weight percent) in the starting silicon nitride powder;

(D) for each of the batches the Vickers hardness (18.5 kg load) reported in GPa (along with the standard deviation);

(E) for each of the batches the fracture toughness (K_{IC}) determined by the Evans and Charles technique and reported in MPa•m ½ (along with the standard deviation); and

(F) for each of the batches the content of the alpha prime SiAlON phase in weight percent of the total of the alpha prime SiAlON phase and the beta prime SiAlON phase.

16. The powder mixtures as set forth in Table 3 were processed as set out in Paragraph 6 hereof.

17. Figures 5 and 6 attached hereto (Exhibit C) comprise backscatter scanning electron microscope (SEM) photomicrographs (with a 40 micrometer legend) of the polished surface wherein these two photomicrographs compare the resulting microstructure of Batch Nos. 1703B and 1417A, respectively. In Figures 5 and 6 the brightest phase is the ytterbia aluminum silicon oxy-nitride grain boundary phase, the medium gray grains are the alpha prime SiAlON phase, and the darkest grains are the beta prime SiAlON phase.

18. A comparison of the microstructure as illustrated in Figures 5 and 6 against the x-ray diffraction results in Table 3 shows that there is a consistency between the microstructure and the x-ray diffraction results in that more alpha prime SiAlON phase is present in Batch No. 1417A as compared to Batch No. 1703B even through the starting powder compositions for Batch Nos. 1417A and 1703B are the same, except for the beta silicon nitride content.

19. A comparison of the microstructure as illustrated in Figures 5 and 6 against the x-ray diffraction results show that the beta prime SiAlON grains in Batch No. 1417A achieve a greater aspect ratio (length/width) so as to be more elongate than the beta prime SiAlON grains in Batch No. 1703B even though the starting powder compositions are the same, except for the beta silicon nitride content.

20. After reviewing the results from the experiments as reported in Tables 1, 2 and 3 and Figures 1-6, it is my opinion that restricting the beta-silicon nitride content to levels of about 1.6 weight percent or less of the starting silicon nitride powder limits the number of beta-silicon nitride particles that are nuclei for the formation of beta prime SiAlON grains during sintering so as to:

(A) result in the formation of fewer beta prime SiAlON grains whereby the beta prime SiAlON grains that are present develop a greater aspect ratio (length/width) (i.e., are more elongate) than if there were more beta-silicon nitride particles in the starting powder mixture;

(B) the presence of the elongate beta prime SiAlON grains generally improves the fracture toughness of the resultant SiAlON ceramic;

(C) achieve higher alpha prime SiAlON contents whereby the higher content of the alpha prime SiAlON phase incorporates more of the rare earth additives into the alpha prime SiAlON phase thereby reducing the amount of the grain boundary phase in the resultant SiAlON ceramic; and

(D) the higher content of alpha prime SiAlON phase generally results in a higher hardness for the resultant SiAlON ceramic.

21. I have reviewed the following references applied in the Office Action mailed on January 9, 2003 in the above-captioned patent application:

(A) English translation of Japanese Patent No. 2988966 (hereinafter JP '966) ;

(B) U.S. Patent No. 5,200,374 (hereinafter US '374);

(C) U.S. Patent No. 5,908,798 (hereinafter US '798);

(D) English translation of Japanese Laid-Open Patent Application No. 5-43333 (hereinafter JP '333); and

(E) U.S. Patent No. 4,574,470 (hereinafter US '470).

22. After a review of JP '966, it is my opinion that primarily due to the use in JP '966 of a starting silicon nitride powder that has about 7 weight percent beta silicon

nitride (i.e., α-silicon nitride conversion of 93%), the resultant ceramic of JP '966 would not present an unexpected increase in the alpha prime SiAlON phase content or present an unexpected elongation of the beta prime SiAlON phase grains so as to achieve an unexpected increase in the hardness and the fracture toughness of the ceramic material.

23. Based upon my review of US'374, and especially the properties of the starting silicon nitride powders as set forth in Table 4 herein below, it is my opinion that

Table 4
Properties of the α-Silicon Nitride Starting Powders for US '374

Property/Powder	Col. 10	Cols. 13-14	Cols. 15-16	Col. 29
Specific Surface Area (m^2/g)	17.5	10.0	11.5	11.5
Particle Shape	Equiaxed crystal	Equiaxed crystal	Equiaxed crystal	Equiaxed crystal
Formed Phase	α-phase > 95%	α-phase > 95%	α-phase > 95%	α-phase > 95%
Oxygen Content (by weight)	2.3%	0.5%	1.3%	Not reported
Metal Impurities	Less than 500 ppm	Less than 500 ppm	Less than 500 ppm	Less than 500 ppm
Yeckley's Opinion on the Beta Content of the Silicon Nitride Powder	At least ≥ 2 wt% beta silicon nitride	SNE-10 (≥ 2 wt% beta silicon nitride)	At least ≥ 2 wt% beta silicon nitride	At least ≥ 2 wt% beta silicon nitride

in the case of the powder identified at Cols. 13-14, the α-silicon nitride starting powder is most likely SNE-10 available from Ube Industries wherein Ube SNE-10 silicon nitride powder contains about 2 or more weight percent beta-silicon nitride, and in the case of the other powders identified at Col. 10, Cols. 15-16 and Col. 29, the α-silicon nitride starting powder most likely contains at least about 2 or more weight percent beta-silicon nitride; that because of the nature of the starting powders used in US '374; namely, an α-SiAlON powder and the above-mentioned silicon nitride powders, it is my opinion that

the resultant ceramic of US '374 would not present an unexpected increase in the alpha prime SiAlON phase content or present an unexpected elongation of the beta prime SiAlON phase grains so as to achieve an unexpected increase in the hardness and the fracture toughness of the ceramic material.

24. Based upon my review of US '798, the starting silicon nitride powder contains about 93 weight percent beta-silicon nitride and about 7 weight alpha-silicon nitride, and that due to the nature of the starting powder mixture, it is my opinion that the resultant ceramic of US '798 would not present an unexpected increase in the alpha prime SiAlON phase content or present an unexpected elongation of the beta prime SiAlON phase grains so as to achieve an unexpected increase in the hardness and the fracture toughness of the ceramic material.

25. Based upon my review of JP'333, the focus of this document is to use a very fine-grained rare earth oxide to achieve the goals of JP'333, and the silicon nitride powder is reported (in the English translation) as "α-silicon nitride powder (UBE Industries)".

26. The compositions set out in Table 1 hereinabove are along the lines of the composition in Example 4 of JP'333, except that the above Table 1 compositions contain about 78 percent more alumina than the alumina in Example 4 of JP'333. Based upon my experience, an increase in the alumina content in the starting powder mixture should result in a decrease in the alpha prime SiAlON content in the resultant SiAlON ceramic so that one would expect that the resultant SiAlON ceramics of Table 1 hereof would have less alpha prime SiAlON phase than Example 4 of JP'333. However, Batch No. 1924D (which has 0 beta-silicon nitride) of Table 1 hereof has almost twice as much alpha prime SiAlON phase in the resultant SiAlON ceramic as does Example 4 of JP'333. In my opinion, this difference in the alpha prime SiAlON content shows that the UBE silicon nitride powder used in JP'333 contained at least 2 weight percent (and possibly more than 2 weight percent) beta-silicon nitride.

27. In light of the alpha prime SiAlON content and the nature of the starting silicon nitride powder for Examples 4 and 9 of JP'333, it is my opinion that the resultant ceramic of JP'333 would not present an unexpected increase in the alpha prime SiAlON phase content or present an unexpected elongation of the beta prime SiAlON phase grains so as to achieve an unexpected increase in the hardness and the fracture toughness of the ceramic material

28. Based upon my review of US'470, the starting silicon nitride powder contains about 10 weight percent beta-silicon nitride since the starting powder is described as containing 90 percent by volume of alpha silicon nitride (see Col. 5, lines 11-13 of US'470). For silicon nitride, the composition as set forth in volume percentages is approximately equivalent to the composition set forth weight percentages. In light of the nature of the starting silicon nitride powder of US'470, it is my opinion that the resultant ceramic of US '470 would not present an unexpected increase in the alpha prime SiAlON phase content or present an unexpected elongation of the beta prime SiAlON phase grains so as to achieve an unexpected increase in the hardness and the fracture toughness of the ceramic material

29. Kennametal makes and sells a cutting insert under the designation KYON 1540 that embodies the invention of the above-captioned patent application wherein the composition (in weight percent) of the starting powder mixture comprises: silicon nitride powder (0 % beta silicon nitride), aluminum nitride powder, alumina powder, and ytterbium oxide powder, and KYON 1540 has an alpha prime SiAlON content of between about 27 weight percent and about 33 weight percent of the total content of alpha prime SiAlON and beta prime SiAlON, a Vickers hardness (18.5 kg load) equal to between about 17.5 GPa and about 18.2 GPa, and a fracture toughness (K_{IC}) as measured by the Evans & Charles method equal to between about 6.7 MPa•$m^{1/2}$ and about 7.2 MPa•$m^{1/2}$.

30. During April of 2002 Kennametal began to advertise the sale of KYON 1540 cutting inserts. Set forth below as Table 5 is a listing of what I understand to be all the advertising materials disseminated by Kennametal where some of the advertisements only advertised KYON 1540 while other advertisements advertised KYON 1540 along with other cutting inserts.

Table 5
Listing of Advertisement Materials

Exhibit	Date(s)	Description	Comments	Cost
D	April, August and September, 2002	Photographic work, printing and distribution of the Kennametal Metalcutting EXTRA Summer 2002 Catalog publication	Two pages out of a catalog comprising a 6 page cover and inside pages 3 through 74	$54,693.88 [Total cost of preparation, printing and distribution of the entire catalog]
E	May, 2002	Preparation and printing of a "Proven in Hi Temp Alloys" Advertisement	one page (two-sided) advertisement	$2725.67
F	September and November, 2002	Preparation and printing of a "Kyon 1540 High Performance Ceramic for Hi Temperature Alloys" Advertisement	8 page advertisement	$9206.34
G	January and March, 2003	Photographic work, printing and distribution of the Kennametal Metalcutting EXTRA Summer 2003 Catalog publication	Three pages out of a catalog comprising an 8 page cover and inside pages 3 through 90	$41,159.72 [Total cost of preparation, printing and distribution of the entire catalog]

31. Beginning in July 2001 (start of Kennametal's fiscal year 2002) through March 31, 2003 (the ninth month of Kennametal's fiscal year 2003) Kennametal has sold a total of 95,007 KYON 1540 cutting inserts for a total sale volume in US dollars equal to \$1,013,137.00. Attachment H hereto is a listing of the monthly sales of KYON 1540 by pieces and sales dollars.

32. Representative field test results are set forth in a summary of these test attached hereto as Attachments I and J. These field test results support the following general conclusions about the performance of KYON 1540:

(A) the tool life of the KYON 1540 cutting inserts is superior to the tool life of competitive commercial SiAlON cutting inserts wherein the typical workpiece material comprises superalloys (e.g., Inconel 718) so as to result in an improvement over available commercial SiAlON cutting inserts; and

(B) in about one-half of the tests the KYON 1540 cutting inserts exhibit a tool life equal to the tool life of silicon carbide whisker-reinforced alumina cutting inserts wherein the typical workpiece material comprises superalloys (e.g., Inconel 718) so as to provide an acceptable lower cost option to silicon carbide whisker-reinforced alumina cutting inserts.

33. In my opinion, the performance results and conclusions about KYON 1540 were unexpected.

34. In my opinion the primary reason for the sale of the KYON 1540 cutting inserts is the superior performance of the KYON 1540 cutting inserts wherein this superior performance is attributable to the higher hardness (which in my opinion is due to the higher alpha prime SiAlON phase content) and the higher toughness (which in my opinion is due to the elongated beta prime SiAlON phase grains) of the KYON 1540 ceramic material.

35. Referring to the nature of the sales of KYON 1540, some of these sales comprise replacements of previous sales of Kennametal KYON 2000 (an α-β SiAlON

[no Yb] that has between about 20 weight percent and about 40 weight percent α-SiAlON and uses a starting silicon nitride powder that contains between about 6 and about 7 weight percent beta silicon nitride) ceramic cutting inserts and Kennametal KYON 2100 (β-SiAlON) ceramic cutting inserts, new sales due to the superior performance of KYON 1540 against competitor's SiAlON ceramic cutting inserts, and new sales due to the equivalent performance of KYON 1540 against silicon carbide whisker reinforced alumina ceramic cutting inserts.

DECLARANT SAYS NOTHING FURTHER

All statements made of my own knowledge are true and all statements made on information and belief are believed to be true. I have been warned that willful false statements and the like are punishable by fine or imprisonment, or both (18 USC1001) and may jeopardize the validity of this application or any patent issuing thereon.

Date 5 June 03

Russell L. Yeckley

EXHIBIT

A

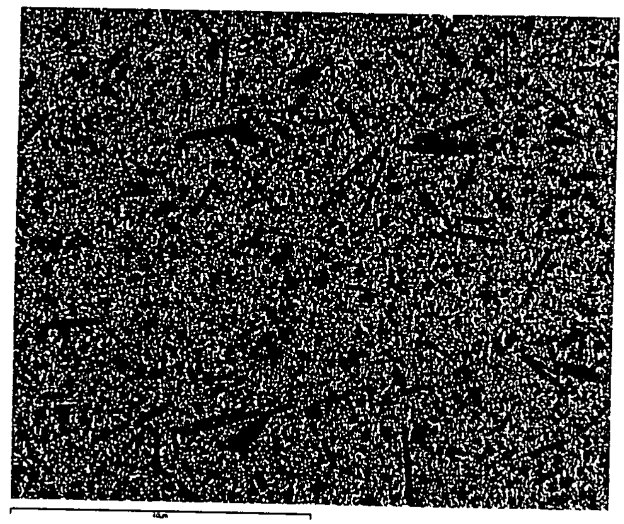


Figure 1. Backscatter SEM image of Sialon composition ab83612 Batch 1924E microstructure.

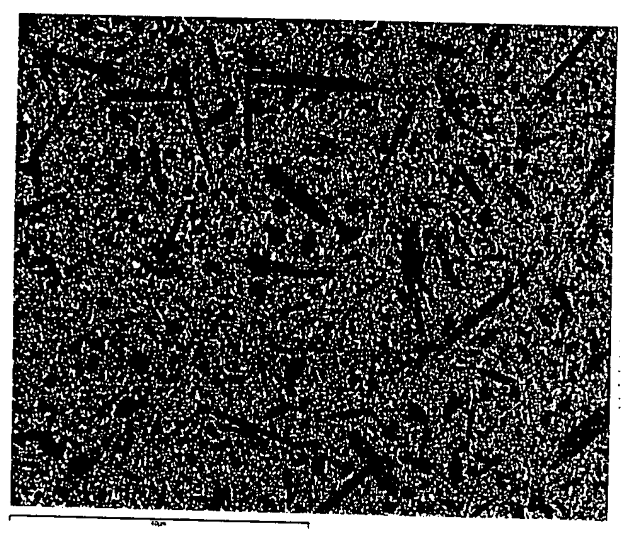


Figure 2. Backscatter SEM image of Sialon composition ab83612 Batch 1924D microstructure

EXHIBIT

B

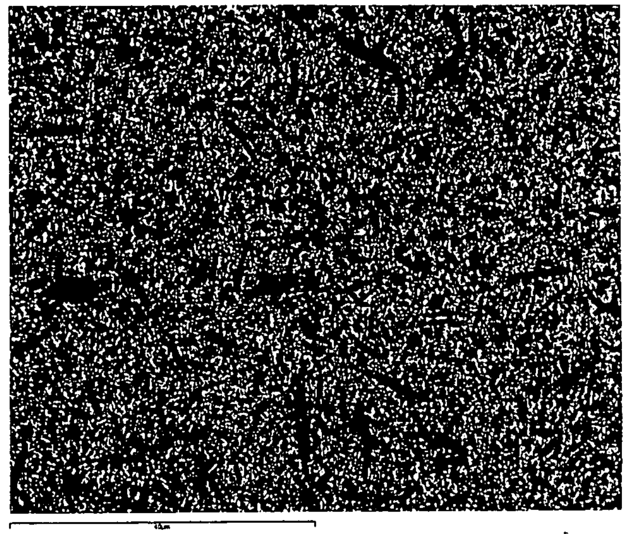


Figure 3. Backscatter SEM image of Sialon composition ab74012 Batch 1860C microstructure

Figure 4. Backscatter SEM image of Sialon composition ab74012 Batch 1914A microstructure

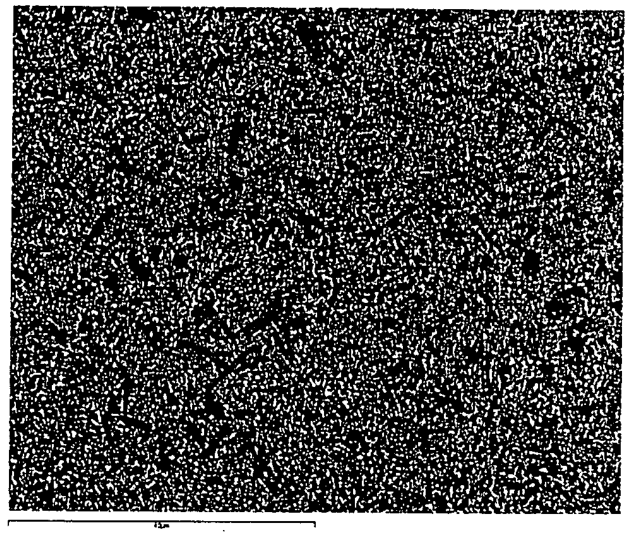


Figure 5. Backscatter SEM image of Sialon composition ab153216 Batch 1703B microstructure

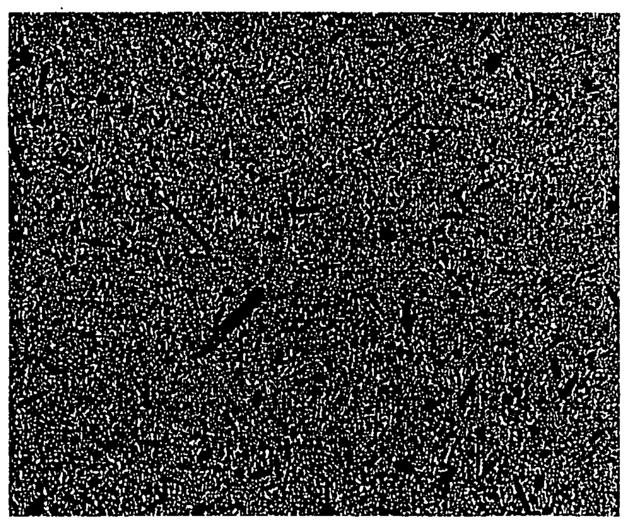


Figure 6. Backscatter SEM image of Sialon composition ab153216 Batch 1417A microstructure

EXHIBIT I

Kyon 1540 Field Test Summary

Alloy	Grade		Insert	Speed sfm	DOC in.	feed ipr	Comments
IN706	KY1540 Ky2000		RNG45 RNG45	1200 850	0.12 0.120	0.012 0.0080	Replacing Ky2000 and Ky2100 with KY1540
IN706	KY1540 Ky2000		RNG45 RNG45	1,100 800	0.120 0.100	0.0145 0.0100	
IN718	KY1540 SX5			800 800	0.15 0.15	0.007 0.007	KY1540 life twice SX5
IN718	KY1540 CC670			1000 1000	0.125 0.125	0.006 0.006	Entered blanket order KY1540 equialent to CC670
IN718	KY1540 CC670			800 800	0.125 0.125	0.006 0.006	
IN718	KY1540 Ky2100			650 650	.100 -.120 .100 -.120	0.012 0.007	70% Productivity improvement
IN718	KY1540 Ky2000 Ky2100			271	0.15	0.01	300 pc SPM014 order entered estimate 5000-6000 per year.
IN706	Ky2100 KY1540		SNG644 SNG644	800	0.265	0.006	KY1540 less chipping In another application with 15 degree lead angle, KY1540 moderate DOCN
IN718	KY1540 WG300		SNG644 SNGN644	706	.150-.350	0.006	KY1540 ran fairly equal to WG-300 slightly more flank wear, but less DOC notching.
IN718	KY1540 WG300		SNG654 SNG654	700	0.15	0.005	Equivalent to WG300
IN718	KY1540 KY1540 Q8	39 Rc	RNG45T0420 RNG45 RNG45T0320	900	.05-.75	0.008	KY1540 ran equal to Q8, Not to End of life.
Inconel D979	KY1540 Q8		RNG45T0420 RNG45T0320	800	0.05	0.006	KY1540 no flaking or chipping, Q8 flaking and chipping. Operator sometimes has to make second pass with Q8 due to chipping.
IN718	KY1540 WG300		RPGV45T0420 RPGN4VT1	900	0.05	0.005	KY1540 had Slightly more edge wear, but completed cut.
IN718	KY1540 WG300		RPGV35T0420 RPGV35T0320	900	.015-.02	0.005	Equivalent to WG300
IN901	H13A Carbide KY1540		CNMG644QM RNG45T0420	100 1000	0.15 0.15	0.016 0.01	KY1540 implemented, estimated annual savings $80,000
IN713	Carbide KY1540	38 Rc	CNMG431 CNGA433T0420	100 600	0.025 0.1	0.006 0.006	KY1540 implemented, estimated annual savings $60,000
IN718	Carbide KY1540	43 Rc	SNMA644 RNG45T0420	73 271	0.05 0.05	0.015 0.01	KY1540 implemented, estimated annual savings $3,000
IN718	SX5 KY1540	44 Rc	RNG65T RNG65T0420	600 600	0.25 0.25	0.006 0.006	KY1540 2X life, estimated annual savings $1,500
IN718	WG300 KY1540		SNG654 SNG645	500 500	0.13 0.13	0.009 0.009	Equivalent to WG300, less notching on KY1540 Estimated annual savings $2,000
IN718	Q8 KY1540	39 Rc	RNG45T00320 RNG45T03420	800 800	0.15 0.15	0.007 0.007	KY1540 performance is equivalent with less wear, estimated annual savings $3000
IN718	WG300 KY1540	39 Rc	RPGV35T0320 RPGV45T0420	900 900	0.02 0.02	0.005 0.005	KY1540 equivalent to WG300, estimated annual savings $3,500
Stellite Inlay in Alloy Steel	WG300 KY1540	58 Rc Inlay 28 Rc Steel	CNGA433T1A CNGA433S0420	600 600	0.125 0.125	0.004 0.004	KY1540 insert life is 4X WG300, speed is limited to 600 sfm max, estimated annual savings $2,200
IN718	WG300 KY1540		RPGN3VT1 RPGV35T0320	600 600	0.075 0.075	0.0024 0.0024	KY1540 broke, did not complete cut

KY1540 TPR Summary

Alloy	Grade	Hardness	Insert	Speed sfm	DOC in.	feed ipr	Comments
IN706	KY1540 Ky2000		RNG45 RNG45	1200 850	0.12 0.120	0.012 0.0080	Replacing Ky2000 and Ky2100 with KY1540
IN706	KY1540 Ky2000		RNG45 RNG45	1,100 800	0.120 0.100	0.0145 0.0100	
IN706	Ky2100 KY1540		SNG644 SNG644	800	0.265	0.006	KY1540 less chipping In another application with 15 degree lead angle, KY1540 moderate DOCN
IN706	KY2000 KY1540		SNG656 SNG657	800 800	0.2 0.2	0.008 0.008	KY1540 5X life, estimated annual savings $750
IN718	KY1540 SX5			800 800	0.15 0.15	0.007 0.007	KY1540 life twice SX5 Entered blanket order
IN718	KY1540 CC670			1000 1000	0.125 0.125	0.006 0.006	KY1540 equialent to CC670
IN718	KY1540 CC670			800 800	0.125 0.125	0.006 0.006	
IN718	KY1540 Ky2100			650 650	.100 -.120 .100 -.120	0.012 0.007	70% Productivity improvement
IN718	KY1540 Ky2000 Ky2100			271	0.15	0.01	300 pc SPM014 order entered estimate 5000-6000 per year.
IN718	KY1540 WG300		SNG644 SNGN644	706	.150-.350	0.006	KY1540 ran fairly equal to WG-300 slightly more flank wear, but less DOC notching.
IN718	KY1540 WG300		SNG654 SNG654	700	0.15	0.005	Equivalent to WG300
IN718	KY1540 KY1540 Q8	39 Rc	RNG45T0420 RNG45 RNG45T0320	900	.05-.75	0.008	KY1540 ran equal to Q8, Not to End of life.
IN718	KY1540 WG300		RPGV45T0420 RPGN4VT1	900	0.05	0.005	KY1540 had Slightly more edge wear, but completed cut.
IN718	KY1540 WG300		RPGV35T0420 RPGV35T0320	900	.015-.02	0.005	Equivalent to WG300
IN718	Carbide KY1540	43 Rc	SNMA644 RNG45T0420	73 271	0.05 0.05	0.015 0.01	KY1540 implemented, estimated annual savings $3,000
IN718	SX5 KY1540	44 Rc	RNG65T RNG65T0420	600 600	0.25 0.25	0.006 0.006	KY1540 2X life, estimated annual savings $1,500
IN718	WG300 KY1540		SNG654 SNG645	500 500	0.13 0.13	0.009 0.009	Equivalent to WG300, less notching on KY1540 Estimated annual savings $2,000
IN718	Q8 KY1540	39 Rc	RNG45T00320 RNG45T03420	800 800	0.15 0.15	0.007 0.007	KY1540 performance is equivalent with less wear, estimated annual savings $3000
IN718	WG300 KY1540	39 Rc	RPGV35T0320 RPGV45T0420	900 900	0.02 0.02	0.005 0.005	KY1540 equivalent to WG300, estimated annual savings $3,500
IN718	WG300 KY1540		RPGN3VT1 RPGV35T0320	600 600	0.075 0.075	0.0024 0.0024	KY1540 broke, did not complete cut WG300 completed cut
IN713	Carbide KY1540	38 Rc	CNMG431 CNGA433T042 0	100 600	0.025 0.1	0.006 0.006	KY1540 implemented, estimated annual savings $60,000
IN901	H13A Carbide KY1540		CNMG644QM RNG45T0420	100 1000	0.15 0.15	0.016 0.01	KY1540 implemented, estimated annual savings $80,000
Inconel D979	KY1540 Q8		RNG45T0420 RNG45T0320	800 800	0.05 0.05	0.006 0.006	KY1540 no flaking or chipping, Q8 flaking and chipping. Operator sometimes has to make second pass with Q8 due to chipping.
Stellite Inlay in Alloy Steel	WG300 KY1540	58 Rc Inlay 28 Rc Steel	CNGA433T1A CNGA433S042 0	600 600	0.125 0.125	0.004 0.004	KY1540 insert life is 4X WG300, speed is limited to 600 sfm max, estimated annual savings $2,200
Waspaloy	KY2100 KY1540	40Rc	SNG644 SNG644	625 625	0.35 0.35	0.007 0.007	KY2100 3X life of KY1540, chipping
A286	H13A Carbide KY1540	33 Rc	CNMG644QM RNG45	140 1000	0.15 0.15	0.016 0.01	KY1540 20X life at higher speed, estimated annual savings of $11,000
Rene 88	WG300 KY2000 KY1540	46 Rc	RNG45T1 RNG45 RNG45	600 600 600	0.02 0.02 0.02	0.01 0.01 0.01	WG300 1.5x life of KY1540 KY1540 1.5x times life of KY2000

Metalcutting

Extra

Technology! Performance! Value!

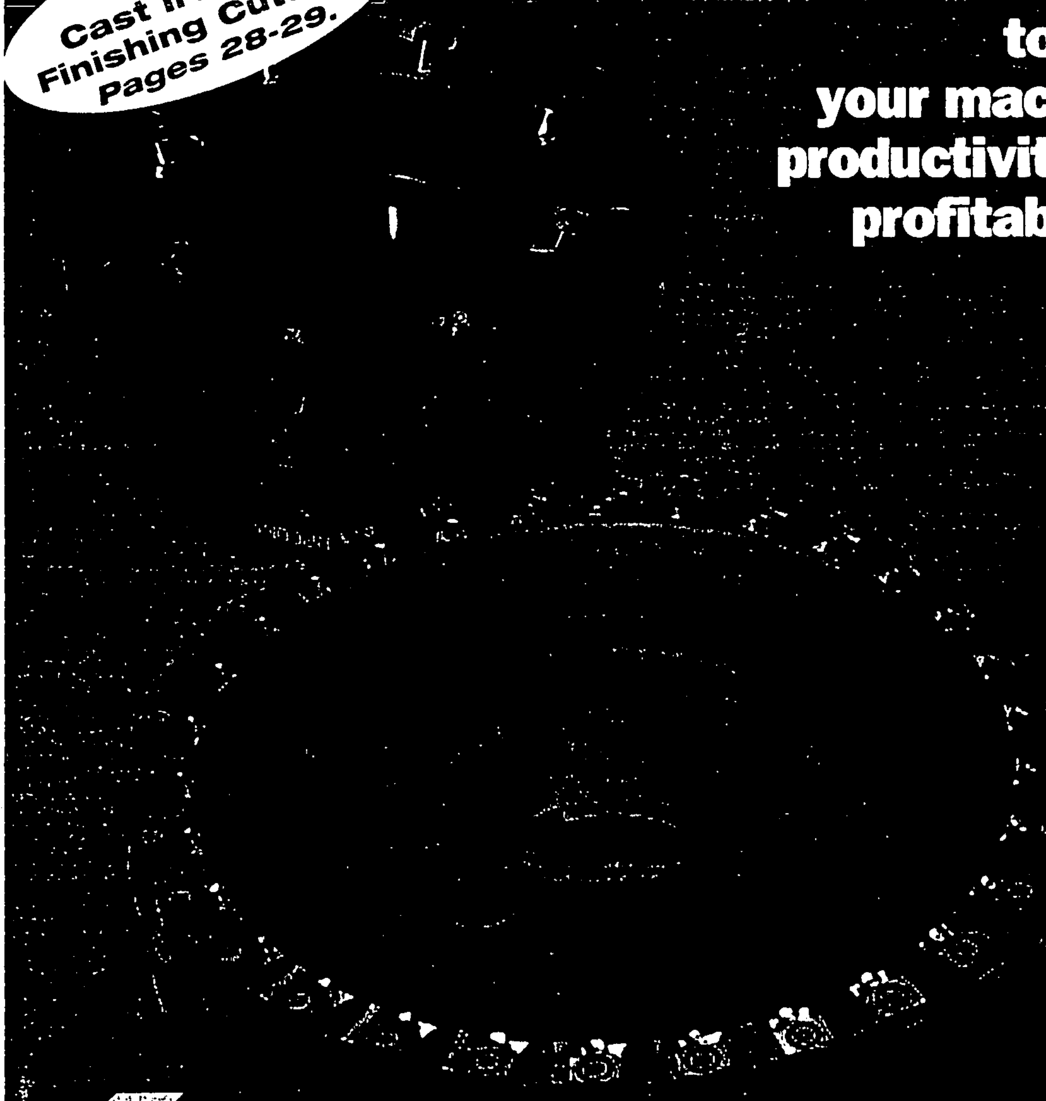
Summer 2002

EXHIBIT
D

PROVEN SOLUTIONS

to boost your machining productivity and profitability.

NEW Cast Iron Fine Finishing Cutters! Pages 28-29.



FEATURING:

- New A4 Groove & Turn tooling!
- New KC9110 & KC9125 turning grades of steel machining!
- New NGE-B indexable insert end mills and shell mills!
- New K284 & K285 solid carbide drills for high-temperature alloys!
- New high-temp alloy milling system with Kyon 2100 ceramic inserts!
- New Shrink-Fit induction heating system and toolholders!

Win a Kennametal Speed Machine!
See details inside.

Kennametal.
The Metalcutting Authority.™

PROVEN.
IN HIGH-TEMP MACHINING.

TURNING

Introducing Kyon 1540 Inserts

TOOLtips

:Y1540 is our newest and
ıost advanced SiALON ceramic
ıaterial for turning high-
:mperature alloys.
nhancements in both its
ardness and toughness levels
nable this grade to run at
igher feed rates than KY2100,
hile still maintaining
utstanding depth-of-cut notch
:sistance. Result: higher
roductivity with much longer
ıol life on these difficult to
ıachine materials.

ıe two edge prep options
lone or .004" K-land) enable
erformance optimization over
wide range of cutting
pplications, from roughing
ırough finishing cuts.

ıpplication Range

ickel-Base Alloys:
50 sfm - 1000 sfm
.003" - 0.012" feed rates

obalt-Base Alloys:
00 sfm - 900 sfm
.003" - 0.012" feed rates

on-Base Alloys:
00 sfm - 800 sfm
.003" - 0.016" feed rates

Need technical assistance? Call our Tech Hotline!

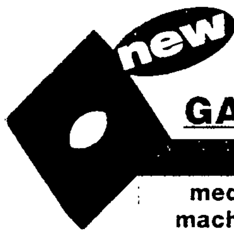
TECH CHECK

800/835-3668

NG

medium machining

ANSI	KY1540
CNG433	◆
CNG434	◆
CNG432T0420	◆
CNG433T0420	◆
CNG434T0420	◆
CNG544T0420	◆
RNG43	◆
RNG45	◆
RNG43T0420	◆
RNG45T0420	◆
SNG644	◆
SNG656	◆
SNG432T0420	◆
SNG433T0420	◆
SNG434T0420	◆
SNG452T0420	◆
SNG453T0420	◆
SNG454T0420	◆
SNG644T0420	◆
TNG433T0420	◆
TNG434T0420	◆
TNG453T0420	◆
TNG454T0420	◆



GA & T

medium machining

ANSI	KY1540
CNGA432	◆
CNGA433	◆
CNGA434	◆
CNGA432T0420	◆
CNGA433T0420	◆
CNGA434T0420	◆
CNGA643T0420	◆
DNGA544	◆
DNGA432T0420	◆
DNGA433T0420	◆
SNGA433T0420	◆
SNGA434T0420	◆
TNGA432T0420	◆
TNGA433T0420	◆

RPGV & T

medium machining

ANSI	KY1540
RPGV35	◆
RPGV45	◆
RPGV35T0420	◆
RPGV45T0420	◆

RCGV & T

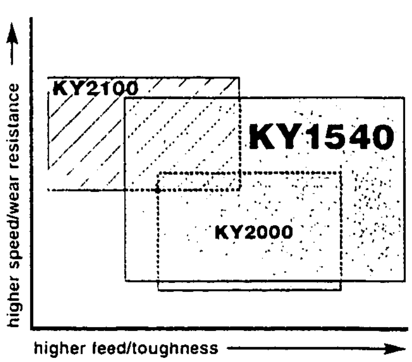
medium machining

ANSI	KY1540
RCGV23	◆
RCGV35	◆
RCGV45	◆
RCGV35T0420	◆
RCGV45T0420	◆

RPG

medium machining

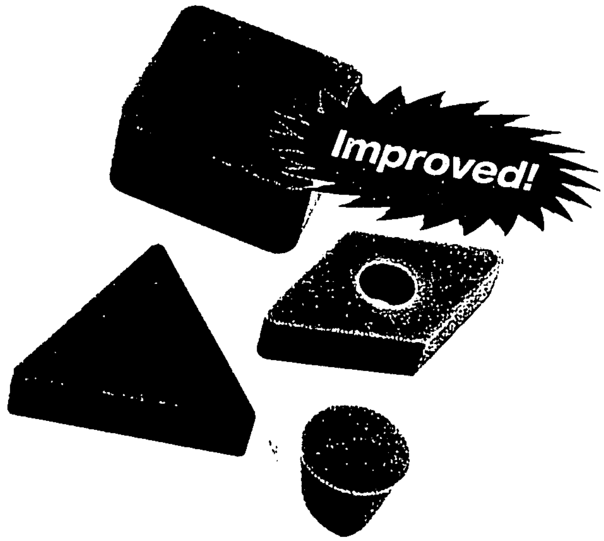
ANSI	KY1540
RPG32	◆
RPG43	◆

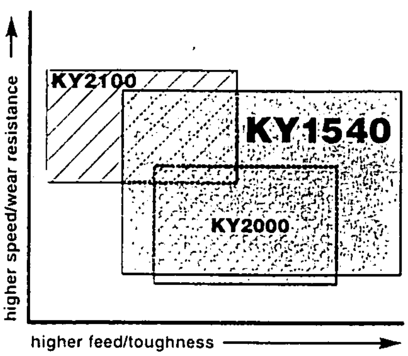


KY1540 — Kennametal cutting grade
KY1540 — KYON, SiALON ceramic grade
KY1540 — Indicates uncoated grade
KY1540 — Suited for material group 5 high-temp alloys
KY1540 — Application group P40 very high toughness

TURNING

Kyon 2100 Inserts for High Speed Machining Nickel-Base Alloys

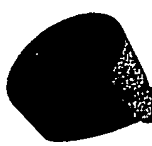




TOOLtips

New process and material technologies derived from grade KY1540 are also being applied to our existing KY2100 SiALON ceramic inserts which remain the preferred choice for medium machining nickel-base alloys such as Inconel, Hastelloy, and Waspaloy at high speeds and light to medium feeds.

As well as high thermal and mechanical-shock resistance, Kyon 2100 has outstanding resistance to depth-of-cut notching, the main failure mode when machining high-temp alloys.



RPGV & T

medium machining

ANSI	KY2100
RPGV-35	◆
RPGV-35T 0420	◆
RPGV-45T 0420	◆

NG & T

medium machining

ANSI	KY2100
CNG-432T 0820	◆
CNG-433T 0420	◆
CNG-434T 0420	◆
RNG-43	◆
RNG-45	◆
RNG-43T 0420	◆
RNG-45T 0420	◆
SNG-433	◆
SNG-434	◆
SNG-644	◆
SNG-434T 0420	◆
SNG-453T 0420	◆

RCGV & T

medium machining

ANSI	KY2100
RCGV-23	◆
RCGV-35	◆
RCGV-45	◆
RCGV-35T 0420	◆
RCGV-45T 0420	◆

GA & T

medium machining

ANSI	KY2100
CNGA433	◆
CNGA-433T 0420	◆
CNGA-434T 0420	◆
SNGA-433T 0420	◆

PROVEN. IN HIGH-TEMP ALLOYS.

NEW! Kyon® 1540...

A HIGH-PERFORMANCE CERAMIC SPECIFICALLY ENGINEERED FOR HIGH-TEMPERATURE ALLOYS.

Key Benefits

A Proven Performer...

- machining a broad range of high-temperature alloys – including Inconels, Waspaloys, and Hastelloys
- involving a wide variety of machining conditions, including cuts with interruptions and scale
- as a cost-effective alternative to whisker ceramic materials

This new Kennametal grade is your first choice Kyon ceramic solution specifically designed for a wide variety of high-temperature alloy machining conditions.

Key Features

- edge prep... offered with a hone or .004 inch (0,1 mm) K-land
- the two edge prep options enable performance optimization over a wide range of cutting applications, from roughing through finishing cuts

A patented composition enables Kyon 1540 to provide improved hardness (wear) and toughness (strength) properties over conventional sialon ceramics.

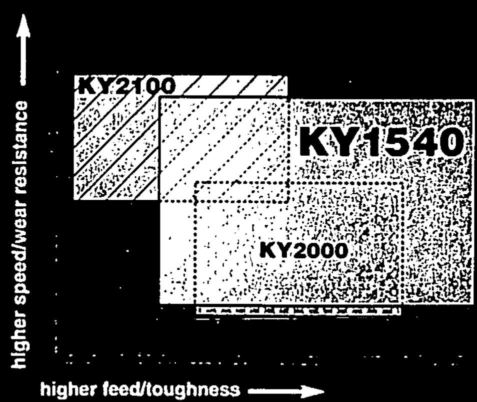
KENNAMETAL

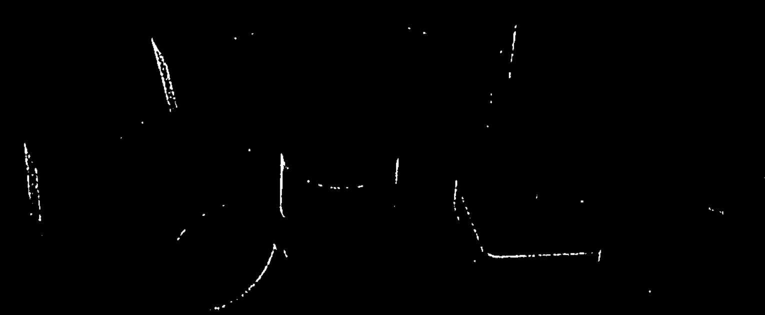
Kennametal.
The Metalcutting Authority™.

www.kennametal.com

New Kyon® 1540...

Kennametal Ceramic Grades for Machining High-Temperature Alloys





Kyon® 1540 Insert Offering

Standard inserts are available June 1, 2002.

insert catalog number	ISO catalog number
CNG432T0420	CNGN120408T01020
CNG433	CNGN120412E
CNG433T0420	CNGN120412T01020
CNG434	CNGN120416E
CNG434T0420	CNGN120416T01020
CNG544T0420	CNGN160616T01020
CNGA432	CNGA120408E
CNGA432T0420	CNGA120408T01020
CNGA433	CNGA120412E
CNGA433T0420	CNGA120412T01020
CNGA434	CNGA120416E
CNGA434T0420	CNGA120416T01020
CNGA643T0420	CNGA190612T01020
DNGA432T0420	DNGA150408T01020
DNGA433T0420	DNGA150412T01020
DNGA544	DNGA190616E
KGF81872	KGF25047608E
KGF82504	KGF25063516E
KGF83752	KGF25095208E
KGF92504	KGF28063516E
RCGV23	RCGX060400E
RCGV35	RCGX090700E
RCGV35T0420	RCGX090700T01020
RCGV45	RCGX120700E
RCGV45T0420	RCGX120700T01020
RNG43	RNGN120400E
RNG43T0420	RNGN120400T01020

insert catalog number	ISO catalog number
RNG45	RNGN120700E
RNG45T0420	RNGN120700T01020
RPG32	RPGN090300E
RPG43	RPGN120400E
RPGV35	RPGX090700E
RPGV35T0420	RPGX090700T01020
RPGV45	RPGX120700E
RPGV45T0420	RPGX120700T01020
SNG432T0420	SNGN120408T01020
SNG433T0420	SNGN120412T01020
SNG434T0420	SNGN120416T01020
SNG452T0420	SNGN120708T01020
SNG453T0420	SNGN120712T01020
SNG454T0420	SNGN120716T01020
SNG644	SNGN190616E
SNG644T0420	SNGN190616T01020
SNG656	SNGN190724E
SNGA433T0420	SNGA120412T01020
SNGA434T0420	SNGA120416T01020
TNG433T0420	TNGN220412T01020
TNG434T0420	TNGN220416T01020
TNG453T0420	TNGN220712T01020
TNG454T0420	TNGN220716T01020
TNGA432T0420	TNGA220408T01020
TNGA433T0420	TNGA220412T01020
TPG322	TPGN160308E

Customer Service (USA and Canada)

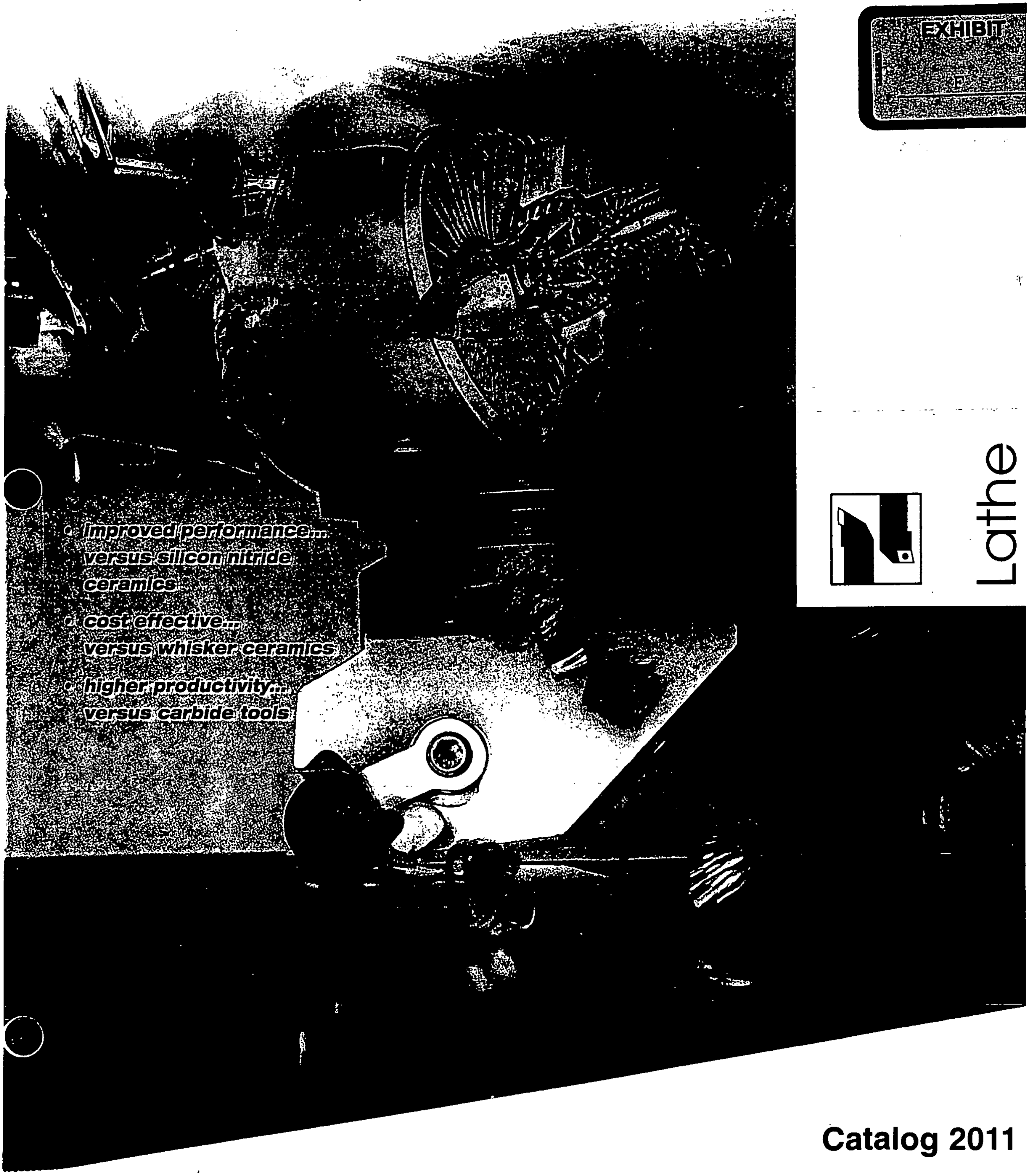
new

KYON® 1540...

High-Performance Ceramic for High-Temperature Alloys

KENNAMETAL®

EXHIBIT



Lathe

Catalog 2011

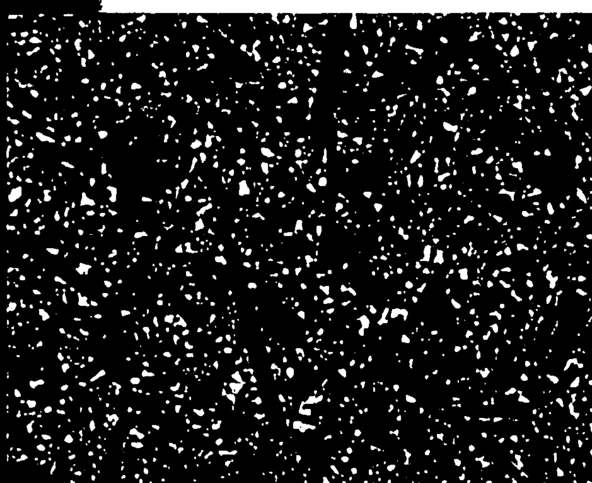
KENNAMETAL

Introducing
New Kyon 1540...

your first choice ceramic solution specifically designed for a wide variety of high-temperature alloy machining conditions!

Kyon 1540 is a Proven Performer...

- in turning and milling applications
- machining a broad range of materials, especially Inconels and other nickel-base high-temperature alloys
- involving a wide variety of machining conditions, including cuts with interruptions and scale
- as a cost-effective alternative to whisker ceramic materials



whisker-shaped beta sialon grains enhance fracture toughness

uniform alpha sialon grain size and composition enhance hardness

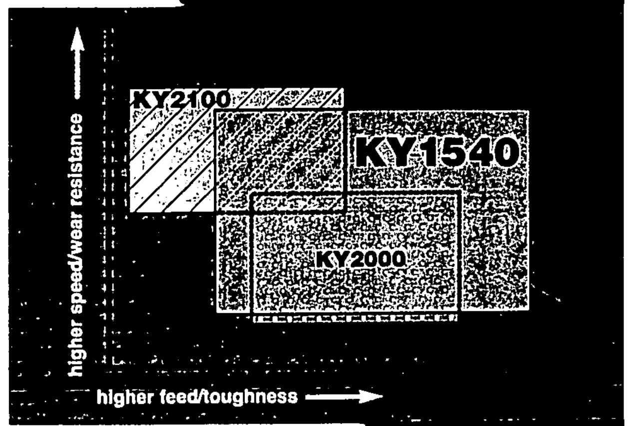
grade	coating	insert styles	composition and application	C class	ISO class
KY1540		turning boring profiling milling	**composition:** KY1540 is the latest and most advanced sialon material ever developed. **application:** Combines excellent wear properties, fracture toughness, and thermal shock resistance for general purpose to finish machining of high-temperature alloys. Provides superior depth of cut notch resistance as compared to whisker ceramics.	C4	M10-M25 K05-K15

PROVEN.

In Aerospace and Power Generation.

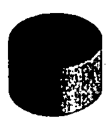
Our unique combination of properties found in Kyon 1540 significantly broaden the effective machining range of sialon ceramics in high-temperature alloy applications!

- runs at higher feeds and speeds for increased productivity
- performs at lower speeds equally well, when restricted by equipment or fixturing limitations, for improved tool life



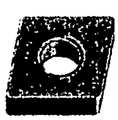
1st Step – Select the Insert Geometry

▼▼ Medium Machining

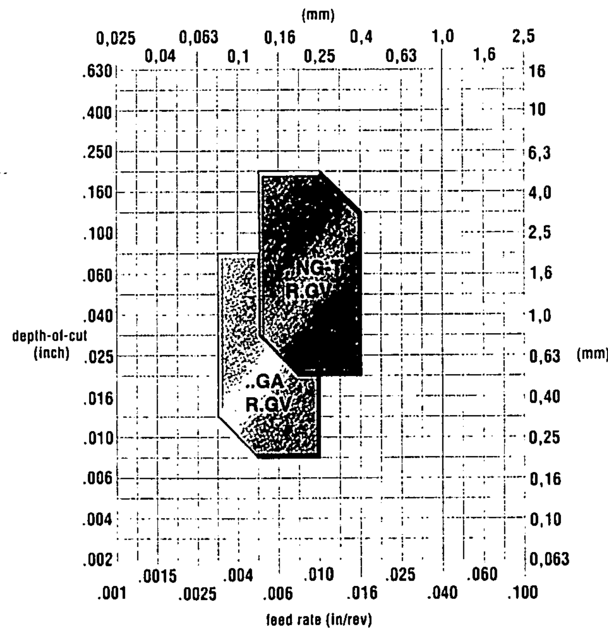

..NG-T


R.GV-T

▼▼▼ Finishing


..GA


R.GV

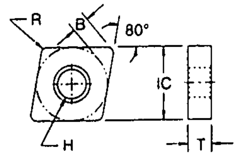
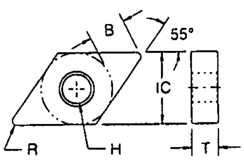
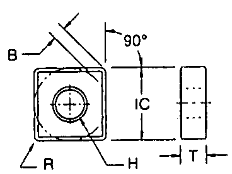
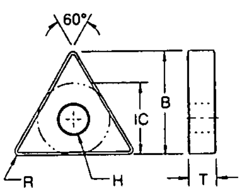
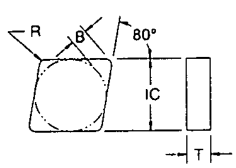
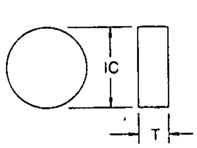
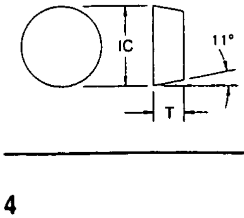


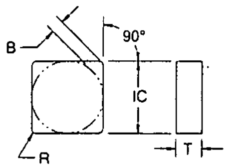
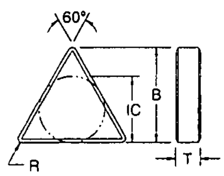
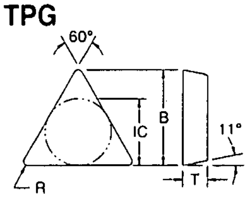
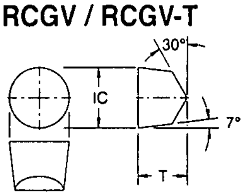
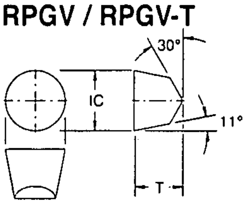
2nd Step – Select the Grade

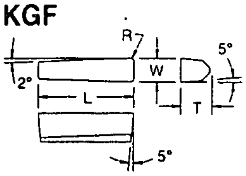
Cutting Condition	Insert Geometry: R.GV ▼▼▼	..GA ▼▼▼	..NG-T ▼▼	R.GV-T ▼▼
heavily interrupted cut	—	—		
lightly interrupted cut	KY1540	KY1540		
varying depth of cut, casting or forging skin	KY1540	KY1540		
smooth cut, pre-turned surface	KY2100	KY2100		

3rd Step – Select the Cutting Speed

Grade	Speed - sfm (m/min): 50 (15)	150 (45)	250 (75)	350 (110)	450 (140)	550 (170)	650 (200)	750 (230)	850 (260)	950 (290)	1050 (320)	Starting Conditions: sfm	m/min
KY1540													

Kenloc & Kendex	Insert catalog number	ISO catalog number	IC inch	IC mm	T inch	T mm	R inch	R mm	B inch	B mm	H inch	H mm
CNGA / CNGA-T 	CNGA-432	CNGA 12 04 08E	1/2	12,70	3/16	4,76	1/32	0,8	.1216	3,088	.203	5,16
	CNGA-433	CNGA 12 04 12E	1/2	12,70	3/16	4,76	3/64	1,2	.1129	2,867	.203	5,16
	CNGA-434	CNGA 12 04 16E	1/2	12,70	3/16	4,76	1/16	1,6	.1042	2,647	.203	5,16
	with T-land (.004" x 20°)											
	CNGA-432T 0420	CNGA 12 04 08T 01020	1/2	12,70	3/16	4,76	1/32	0,8	.1216	3,088	.203	5,16
	CNGA-433T 0420	CNGA 12 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.1129	2,867	.203	5,16
	CNGA-434T 0420	CNGA 12 04 16T 01020	1/2	12,70	3/16	4,76	1/16	1,6	.1042	2,647	.203	5,16
	CNGA-643T 0420	CNGA 19 06 12T 01020	3/4	19,05	1/4	6,35	3/64	1,2	.1823	4,632	.312	7,93
DNGA / DNGA-T 	DNGA-544	DNGA 19 06 16E	5/8	15,88	1/4	6,35	1/16	1,6	.2914	7,402	.250	6,35
	with T-land (.004" x 20°)											
	DNGA-432T 0420	DNGA 15 04 08T 01020	1/2	12,70	3/16	4,76	1/32	0,8	.2550	6,477	.203	5,16
	DNGA-433T 0420	DNGA 15 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.2368	6,014	.203	5,16
SNGA-T 	with T-land (.004" x 20°)											
	SNGA-433T 0420	SNGA 12 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.0841	2,137	.203	5,16
	SNGA-434T 0420	SNGA 12 04 16T 01020	1/2	12,70	3/16	4,76	1/16	1,6	.0777	1,973	.203	5,16
TNGA-T 	with T-land (.004" x 20°)											
	TNGA-432T 0420	TNGA 22 04 08T 01020	1/2	12,70	3/16	4,76	1/32	0,8	.7188	18,256	.203	5,16
	TNGA-433T 0420	TNGA 22 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.7031	17,859	.203	5,16
CNG / CNG-T 	CNG-433	CNGN 12 04 12E	1/2	12,70	3/16	4,76	3/64	1,2	.1129	2,867	–	–
	CNG-434	CNGN 12 04 16E	1/2	12,70	3/16	4,76	1/16	1,6	.1042	2,647		
	with T-land (.004" x 20°)											
	CNG-432T 0420	CNGN 12 04 08T 01020	1/2	12,70	3/16	4,76	1/32	0,8	.1216	3,088	–	–
	CNG-433T 0420	CNGN 12 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.1129	2,867	–	–
	CNG-434T 0420	CNGN 12 04 16T 01020	1/2	12,70	3/16	4,76	1/16	1,6	.1042	2,647	–	–
	CNG-544T 0420	CNGN 16 06 16T 01020	5/8	15,88	1/4	6,35	1/16	1,6	.1389	3,529	–	–
RNG / RNG-T 	RNG-43	RNGN 12 04 00E	1/2	12,70	3/16	4,76	–	–	–	–	–	–
	RNG-45	RNGN 12 07 00E	1/2	12,70	5/16	7,94	–	–	–	–	–	–
	RNG-65	RNGN 19 07 00E	3/4	19,05	5/16	7,94	–	–	–	–	–	–
	with T-land (.004" x 20°)											
	RNG-43T 0420	RNGN 12 04 00T 01020	1/2	12,70	3/16	4,76	–	–	–	–	–	–
	RNG-45T 0420	RNGN 12 07 00T 01020	1/2	12,70	5/16	7,94	–	–	–	–	–	–
	RNG-65T 0420	RNGN 19 07 00T 01020	3/4	19,05	5/16	7,94	–	–	–	–	–	–
RPG 	RPG-32	RPGN 09 03 00E	3/8	9,53	1/8	3,18	–	–	–	–	–	–
	RPG-43	RPGN 12 04 00E	1/2	12,70	3/16	4,76	–	–	–	–	–	–

Kendex & Positive Profiling	Insert catalog number	ISO catalog number	IC inch	IC mm	T inch	T mm	R inch	R mm	B inch	B mm
SNG / SNG-T	SNG-644	SNGN 19 06 16E	3/4	19,05	1/4	6,35	1/16	1,6	.1294	3,288
	SNG-656	SNGN 19 07 24E	3/4	19,05	5/16	7,94	3/32	2,4	.1165	2,959
	with T-land (.004" x 20°)									
	SNG-432T 0420	SNGN 12 04 08T 01020	1/2	12,70	3/16	4,76	1/32	0,8	.0906	2,301
	SNG-433T 0420	SNGN 12 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.0841	2,137
	SNG-434T 0420	SNGN 12 04 16T 01020	1/2	12,70	3/16	4,76	1/16	1,6	.0777	1,973
	SNG-452T 0420	SNGN 12 07 08T 01020	1/2	12,70	5/16	7,94	1/32	0,8	.0906	2,301
	SNG-453T 0420	SNGN 12 07 12T 01020	1/2	12,70	5/16	7,94	3/64	1,2	.0841	2,137
	SNG-454T 0420	SNGN 12 07 16T 01020	1/2	12,70	5/16	7,94	1/16	1,6	.0777	1,973
	SNG-644T 0420	SNGN 19 06 16T 01020	3/4	19,05	1/4	6,35	1/16	1,6	.1294	3,288
TNG-T 	with T-land (.004" x 20°)									
	TNG-433T 0420	TNGN 22 04 12T 01020	1/2	12,70	3/16	4,76	3/64	1,2	.7031	17,859
	TNG-434T 0420	TNGN 22 04 16T 01020	1/2	12,70	3/16	4,76	1/16	1,6	.6875	17,463
	TNG-453T 0420	TNGN 22 07 12T 01020	1/2	12,70	5/16	7,94	3/64	1,2	.7031	17,859
	TNG-454T 0420	TNGN 22 07 16T 01020	1/2	12,70	5/16	7,94	1/16	1,6	.6875	17,463
TPG 	TPG-322	TPGN 16 03 08E	3/8	9,53	1/8	3,18	1/32	0,8	.5313	13,494
RCGV / RCGV-T	RCGV-23	RCGX 06 04 00E	1/4	6,35	.188	4,78	–	–	–	–
	RCGV-35	RCGX 09 07 00E	3/8	9,53	.312	7,92	–	–	–	–
	RCGV-45	RCGX 12 07 00E	1/2	12,70	.312	7,92	–	–	–	–
	with T-land (.004" x 20°)									
	RCGV-35T 0420	RCGX 09 07 00T 01020	3/8	9,53	.312	7,92	–	–	–	–
	RCGV-45T 0420	RCGX 12 07 00T 01020	1/2	12,70	.312	7,92	–	–	–	–
RPGV / RPGV-T	RPGV-35	RPGX 09 07 00E	3/8	9,53	.312	7,92	–	–	–	–
	RPGV-45	RPGX 12 07 00E	1/2	12,70	.312	7,92	–	–	–	–
	with T-land (.004" x 20°)									
	RPGV-35T 0420	RPGX 09 07 00T 01020	3/8	9,53	.312	7,92	–	–	–	–
	RPGV-45T 0420	RPGX 12 07 00T 01020	1/2	12,70	.312	7,92	–	–	–	–

Kendex V-Bottom Deep Grooving System	Insert catalog number	ISO catalog number	W inch	W mm	R inch	R mm	L inch	L mm	T inch	T mm	B inch	B mm
KGF	KGF-8187-2	KGF 25 04 76 08E	.187	4,32	.031	0,79	1	25,40	.328	8,31	–	–
	KGF-8250-4	KGF 25 06 35 16E	.250	6,35	.062	1,58	1	25,40	.328	8,31	–	–
	KGF-8375-2	KGF 25 09 52 08E	.375	9,52	.031	0,79	1	25,40	.328	8,31	–	–
	KGF-9250-4	KGF 28 06 35 16E	.250	6,35	.062	1,58	1 1/8	28,58	.328	8,31	–	–

METALCUTTING EXTRA

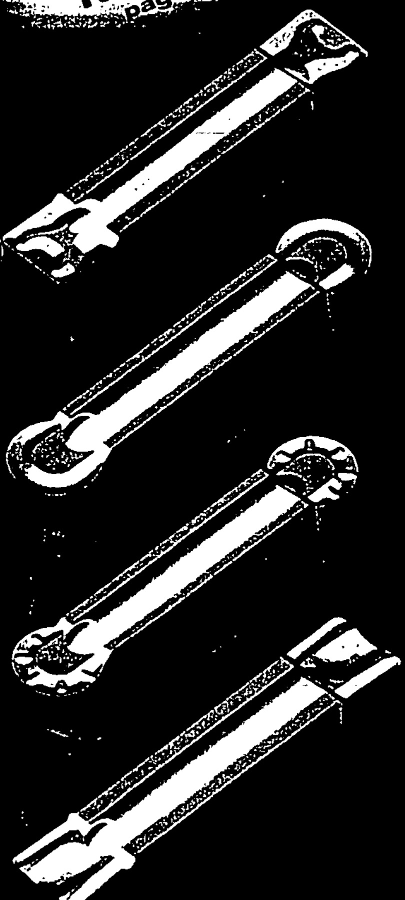
TECHNOLOGY • PERFORMANCE • VALUE

Spring 2003

PROVEN SOLUTIONS

to boost your machining productivity and profitability!

NEW A4 Groove and Turn Tooling! pages 58-63



FEATURING:

New KC915M milling grade for cast and ductile iron!

New KC935M milling grade for steel, stainless steel, and ductile iron!

New KD1405 diamond sheet turning and milling grade for aluminum!

New Kyon 1540 ceramic inserts for high-temp/heat-resistant alloys!

New KB9640, the industry's first CVD alumina-coated PCBN grade!

See These Products at WESTEC March 24-27, LA Convention Center, Booth #3032

PROVEN

PROVEN.

IN HIGH-TEMP MACHINING.

MILLING

TOOLtips

Our new KDNR and KIPR Cutter Bodies are designed specifically for Kyon 2100 grade ceramic inserts and will help you attain surface speeds in excess of 3,000 sfm. The cutter's rugged clamping system was developed to operate at elevated spindle speeds while machining nickel-based, heat-resistant alloys such as Inconel 625, 718, and other difficult-to-machine materials. These cutters, with Kyon 2100 inserts, generally work best when run dry and supplied with a through-the-spindle air blast for chip evacuation.

Grade KY2100 is a silicon nitride (sialon) based ceramic. Its high thermal and mechanical shock resistance makes it ideal for light to heavy rough milling of PH and 300 series stainless steel as well as nickel- and cobalt-base heat-resistant materials such as Inconel and Waspaloy. Kyon 2100 has outstanding resistance to depth-of-cut notching, the main failure mechanism when machining high-temp alloys.

Kyon 1540 is our newest and most advanced sialon grade. It has moderately higher thermal and mechanical shock resistance than KY2100. Grade KY1540 should be used for low to high-speed rough milling of nickel, cobalt, and iron-base heat-resistant alloys at speeds ranging from 2000 to over 3000 sfm.

New Milling System with Kyon 2100 Ceramic Inserts for High-Temp/ Heat-Resistant Alloys

Increase Surface Speeds to Over 3,000 SFM and Reduce Cut Time by 60% or More!

Kennametal Engineer: Doug Armond and Bob Fisher
Market: Oil and Gas
Product: Rough mill flats on 6 1/4" O.D. tube
Material: Inconel 718

	KENNAMETAL	COMPETITION
cutter	KDNR300RN40C4	indexable insert cutter
grade	KY2100	coated carbide
insert	RNG45T0420	octogon
speed	3,200 sfm	80 sfm
feed	.003 ipt (61 ipm)	.007 ipt (3.7 ipm)
axial d.o.c	.080	.100
radial d.o.c	1.50	1.50

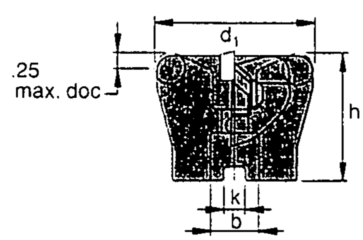
cost savings:
$8,000
time reduction:
56 minute per part was reduced to 5 minutes per part.

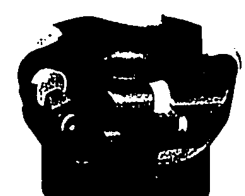
Kennametal Engineer: Ed Skrzynski
Market: Aerospace
Product: Jet engine flange
Material: AMS 5772 - Haynes 188 26 HRC

	KENNAMETAL	COMPETITION
cutter	KDNR400RN40C5	indexable insert cutter
grade	KY2100	coated carbide
insert	RNG45T0420	OFER070405TNME10
speed	3,500 sfm	52 sfm
feed	.004 ipt (92 ipm)	.0035 ipt (1 ipm)
axial d.o.c	.035	.035
radial d.o.c	2.50	2.50

cost savings:
$18,167 on this part annually. When the process was implemented on other machines the cost savings was $250,000 annually.
time reduction:
1 hour per part was reduced to less then 1 minute per part.

These cutters and inserts are your best choice for milling PH Stainless and 300 Series Stainless Steel

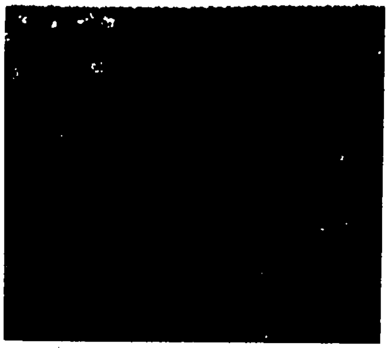




new

KSSR-RP - Positive Rake Shell Mills

cutting diameter d_1	catalog number	insert catalog number	number of inserts	height h_1	bore b	keyway k	clamp	clamp screw	max. rpm	weight lbs.
2.00	KSSR200RP430C3	RPG43	3	2.00	.75	.331	KCI-3	S-1997	16,000	<2.0
2.00	KSSR200RP430F3	RPG43	4	2.00	.75	.331	KCI-3	S-1997	16,000	<2.0
2.50	KSSR250RP430C3	RPG43	4	2.00	.75	.331	KCI-3	S-1997	14,500	<2.0
3.00	KSSR300RP430C4	RPG43	5	2.00	1.00	.390	KCI-3	S-1997	13,500	<2.0
4.00	KSSR400RP430C5	RPG43	6	2.00	1.25	.515	KCI-3	S-1997	11,500	3.5



PROVEN.

IN HIGH-TEMP MACHINING.

TURNING

Introducing Kyon 1540 Inserts

TOOLtips

KY1540 is our newest and most advanced sialon ceramic material for turning high-temperature alloys. Enhancements in both its hardness and toughness levels enable this grade to run at higher feed rates than KY2100, while still maintaining outstanding depth-of-cut notch resistance. Result: higher productivity with much longer tool life on these difficult to machine materials.

The two edge prep options (hone or .004 K-land) enable performance optimization over a wide range of cutting applications, from roughing through finishing cuts.

Application Range

Nickel-Base Alloys:

450 sfm - 1000 sfm
.003 - .012 feed rates

Cobalt-Base Alloys:

300 sfm - 900 sfm
.003 - .012 feed rates

Iron-Base Alloys:

300 sfm - 800 sfm
.003 - .016 feed rates

Need technical assistance? Call our Tech Hotline!

TECH CHECK

800/835-3668

new

NG

medium machining

ANSI	KY1540
CNG433	◆
CNG434	◆
CNG432T0420	◆
CNG433T0420	◆
CNG434T0420	◆
CNG544T0420	◆
RNG43	◆
RNG45	◆
RNG43T0420	◆
RNG45T0420	◆
SNG644	◆
SNG656	◆
SNG432T0420	◆
SNG433T0420	◆
SNG434T0420	◆
SNG452T0420	◆
SNG453T0420	◆
SNG454T0420	◆
SNG644T0420	◆
TNG433T0420	◆
TNG434T0420	◆
TNG453T0420	◆
TNG454T0420	◆

new

GA & T

medium machining

ANSI	KY1540
CNGA432	◆
CNGA433	◆
CNGA434	◆
CNGA432T0420	◆
CNGA433T0420	◆
CNGA434T0420	◆
CNGA643T0420	◆
DNGA544	◆
DNGA432T0420	◆
DNGA433T0420	◆
SNGA433T0420	◆
SNGA434T0420	◆
TNGA432T0420	◆
TNGA433T0420	◆

new

RPGV & T

medium machining

ANSI	KY1540
RPGV35	◆
RPGV45	◆
RPGV35T0420	◆
RPGV45T0420	◆

new

RCGV & T

medium machining

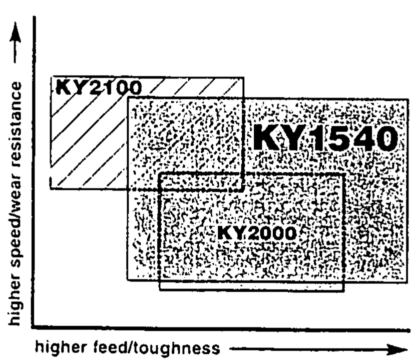
ANSI	KY1540
RCGV23	◆
RCGV35	◆
RCGV45	◆
RCGV35T0420	◆
RCGV45T0420	◆

new

RPG

medium machining

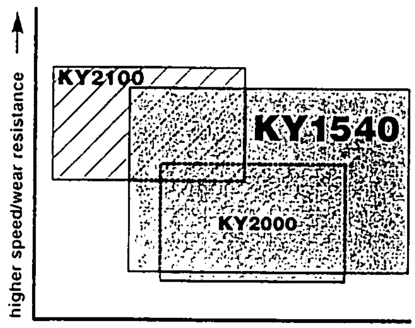
ANSI	KY1540
RPG32	◆
RPG43	◆

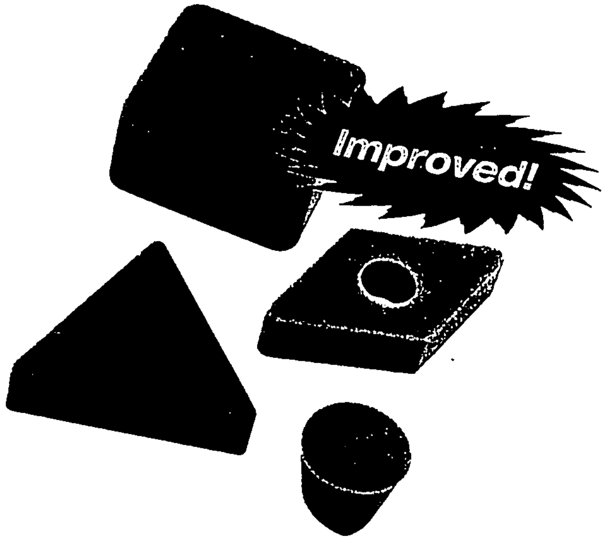


KY1540 — Kennametal cutting grade
KY1540 — KYON sialon ceramic grade
KY1540 — Indicates uncoated grade
KY1540 — Suited for material group 5 high-temp alloys
KY1540 — Application group M-40 very high toughness

TURNING

Kyon 2100 Inserts for High Speed Machining Nickel-Base Alloys

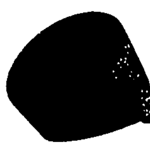




TOOLtips

New process and material technologies derived from grade KY1540 are also being applied to our existing KY2100 sialon ceramic inserts which remain the preferred choice for medium machining nickel-base alloys such as Inconel, Hastelloy, and Waspaloy at high speeds and light to medium feeds.

As well as high thermal and mechanical shock resistance, Kyon 2100 has outstanding resistance to depth-of-cut notching, the main failure mode when machining high-temp alloys.



RPGV & T

medium machining

ANSI	KY2100
RPGV-35	◆
RPGV-35T 0420	◆
RPGV-45T 0420	◆

NG & T

medium machining

ANSI	KY2100
CNG-432T 0820	◆
CNG-433T 0420	◆
CNG-434T 0420	◆
RNG-43	◆
RNG-45	◆
RNG-43T 0420	◆
RNG-45T 0420	◆
SNG-433	◆
SNG-434	◆
SNG-644	◆
SNG-434T 0420	◆
SNG-453T 0420	◆

RCGV & T

medium machining

ANSI	KY2100
RCGV-23	◆
RCGV-35	◆
RCGV-45	◆
RCGV-35T 0420	◆
RCGV-45T 0420	◆

GA & T

medium machining

ANSI	KY2100
CNGA433	◆
CNGA-433T 0420	◆
CNGA-434T 0420	◆
SNGA-433T 0420	◆

Enroll in our five-day application engineering course!

KENNAMETAL UNIVERSITY

(724) 539-6828

EXHIBIT

H

KY1540 Sales (Including as SPM014)

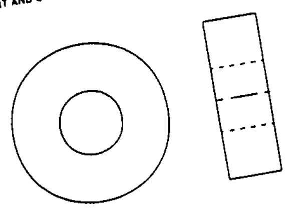
Fiscal Year	Month	Sales Pieces	Sales Dollars
FY 2002	1	807	$ 8,017
	2	2,447	$ 24,041
	3	856	$ 8,517
	4	2,970	$ 28,578
	5	4,500	$ 44,775
	6	5,600	$ 55,720
	7	7,643	$ 80,049
	8	6,500	$ 63,957
	9	10,906	$ 111,021
	10	5,220	$ 54,665
	11	11,564	$ 120,465
	12	5,384	$ 57,586
FY2003	1	2,872	$ 29,177
	2	3,273	$ 35,877
	3	2,254	$ 25,529
	4	2,457	$ 30,811
	5	2,144	$ 25,327
	6	3,363	$ 37,941
	7	3,518	$ 44,363
	8	4,442	$ 52,841
	9	6,287	$ 73,879
		95,007	1,013,137

Proven Successes

Tool Performance Report

Company	ABC Machining Company
Location	Connecticut
Part	Ring
Machine and Type	Lathe
Operation	Face
Date	6/1/02
Engineer	Dave Smith
Material	Inconel 901
Condition	Premachined
Hardness	320 BHN
Condition of Machine	Good

PART AND OPERATION



	Competitor Carbide	Kennametal KY1540
Cutting Speed (sfm)	100	1000
Pieces/Insert	0.1	8
Est. Annual Savings		$80,000

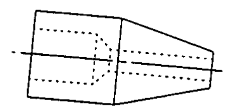
PERFORMANCE, TECHNICAL, AND COST DATA	COMPETITOR	KENNAMETAL
Tool Used	MCLNR-206D	MRGNLC-204D
Insert Used	CNMG-644	RNG-45T 0420
Grade	Carbide	KY1540
Workpiece Diameter (in.)	36	36
DOC	.150	.150
Feed Rate (IPR)	.016	.010
Cutting Speed (SFM)	100	1,000
Cutting Time/Piece (min)	1,020	165
Pieces/Edge	.025	0.5
Cutting Edges/Insert	4	16
Pieces/Insert	.1	8.0
Reason for Indexing	FLW	Chipping
Estimated Annual Savings		$80,000

Tool Performance Report

Company	Best Manufacturing
Location	Massachusetts
Part	Nozzle
Machine and Type	Lathe
Operation	Rough Face
Date	6/10/02
Engineer	John Doest
Material	Inconel 713
Condition	Casting
Hardness	350 BHN
Condition of Machine	Good

PART AND OPERATION

	Competitor Carbide	Kennametal KY1540
Cutting Speed (sfm)	100	600
Pieces/Insert	.8	4.0
Est. Annual Savings		$50,000

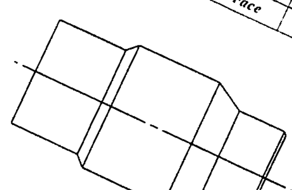


PERFORMANCE, TECHNICAL, AND COST DATA	COMPETITOR	KENNAMETAL
Tool Used	DCLNR-164D-KC3	DCLNR-164D-KC3
Insert Used	CNMG-432	CNGA-433T 0420
Grade	Carbide	KY1540
Workpiece Diameter (in.)	10	10
DOC	.025	.100
Feed Rate (IPR)	.006	.006
Cutting Speed (SFM)	100	600
Cutting Time/Piece (sec.)	2,200	130
Pieces/Edge	.2	1
Cutting Edges/Insert	4	4
Pieces/Insert	.8	4
Reason for Indexing	Chipping	DOC Notch
Estimated Annual Savings		$50,000

...nce Report

Company	Metalworking Experts, Inc.
Location	Pennsylvania
Machine and Type	Lathe
Operation	Rough Turn OD and Face
Date	6/17/02
Engineer	James Brown
Material	Inconel 718
Condition	Forging with Scale
Hardness	400 BHN
Condition of Machine	Good
HP	50

PART AND OPERATION



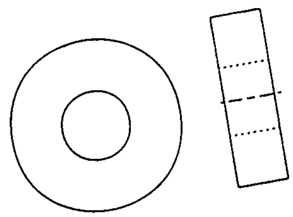
	Competitor Si_3N_4 Ceramic	Kennametal KY1540
Pieces/Edge	.5	1
Pieces/Insert	3	6
Est. Annual Savings		$2,000

PERFORMANCE, TECHNICAL, AND COST DATA	COMPETITOR	KENNAMETAL
Tool Used	MRNGL-206D	MRNGL-206D
Insert Used	RNG-65T	RNG-65T 0420
Grade	Silicon Nitride Ceramic	KY1540
Workpiece Diameter (in.)	6	6
DOC	.250	.250
Feed Rate (IPR)	.006	.006
Cutting Speed (SFM)	600	600
Pieces/Edge	.5	1
Cutting Edges/Insert	6	6
Pieces/Insert	3	6
Reason for Indexing	FLW and DOC Notch	FLW and DOC Notch
Estimated Annual Savings		$2,000

Tool Performance Report

COMPANY	Top Tooling	DATE	6/21/02
ENGINEER	Tom Jones	LOCATION	Vermont
MATERIAL	Inconel 718	PART	Ring
CONDITION	Forging	MACHINE AND TYPE	Lathe
HARDNESS	320 BHN	OPERATION	Turn OD and Face
CONDITION OF MACHINE	Good	HP	
CONSTANT SFM	☐ YES ☐ NO		

PART AND OPERATION



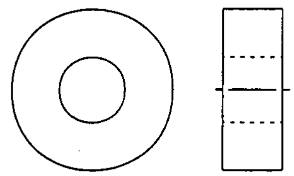
	Competitor Si_3N_4 Ceramic	Kennametal KY1540
Pieces/Edge	2	4
Pieces/Insert	16	32
Est. Annual Savings		$6,000

PERFORMANCE, TECHNICAL, AND COST DATA	COMPETITOR	KENNAMETAL
Tool Used	CRGNR-854	CRGNR-854
Insert Used	RNG-45T	RNG-45T 0420
Grade	Silicon Nitride Ceramic	KY1540
Workpiece Diameter (in.)	16	16
DOC	.150	.150
Feed Rate (IPR)	.007	.007
Cutting Speed (SFM)	800	800
Pieces/Edge	2	4
Cutting Edges/Insert	8	8
Pieces/Insert	16	32
Reason for Indexing	DOC Notch	DOC Notch
Estimated Annual Savings		$6,000

Tool Performance Report

COMPANY	Uptime Plus	DATE	7/2/02
ENGINEER	Michael Gray	LOCATION	Georgia
MATERIAL	Inconel 718	PART	Ring
CONDITION	As-Forged	MACHINE AND TYPE	Lathe
HARDNESS	360 BHN	OPERATION	Rough Turn OD
CONDITION OF MACHINE	Good	HP	
CONSTANT SFM	☐ YES ☐ NO		

PART AND OPERATION



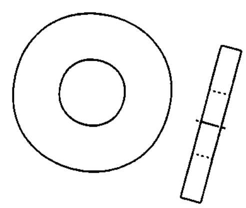
	Competitor Al_2O_3/SiC_w Ceramic	Kennametal KY1540
Pieces/Edge	1	1
Pieces/Insert	8	8
Est. Annual Savings		$2,000

PERFORMANCE, TECHNICAL, AND COST DATA	COMPETITOR	KENNAMETAL
Tool Used	MSRNL-204D	MSRNL-204D
Insert Used	SNG-654	SNG-654
Grade	SiC Whisker Ceramic	KY1540
Workpiece Diameter (in.)	28	28
DOC	.130	.130
Feed Rate (IPR)	.009	.009
Cutting Speed (SFM)	500	500
Pieces/Edge	1	1
Cutting Edges/Insert	8	8
Pieces/Insert	8	8
Reason for Indexing	DOC Notch	DOC Notch
Estimated Annual Savings		$2,000

...ance

COMPANY	Precision Parts	MATERIAL	...718
LOCATION	New York	ENGINEER	...ichard West
PART	Disc	CONDITION	Forging
MACHINE AND TYPE	Lathe	HARDNESS	380 BHN
OPERATION	Finish Profile	CONDITION OF MACHINE	Good
HP	40	CONSTANT SFM	☐ YES ☐ NO

PART AND OPERATION



	Competitor Al_2O_3/SiC_w Ceramic	Kennametal KY1540
Pieces/Edge	1	1
Pieces/Insert	2	2
Est. Annual Savings		$3,000

PERFORMANCE, TECHNICAL, AND COST DATA	COMPETITOR	KENNAMETAL
Tool Used	411157-3VRS	411157-3VRS
Insert Used	RPGV-35T	RPG-35T 0420
Grade	SiC Whisker Ceramic	KY1540
Workpiece Diameter (in.)	8	8
DOC	.020	.020
Feed Rate (IPR)	.005	.005
Cutting Speed (SFM)	900	900
Pieces/Edge	1	1
Cutting Edges/Insert	2	2
Pieces/Insert	2	2
Reason for Indexing	Edge Wear	Edge Wear
Estimated Annual Savings		$3,000

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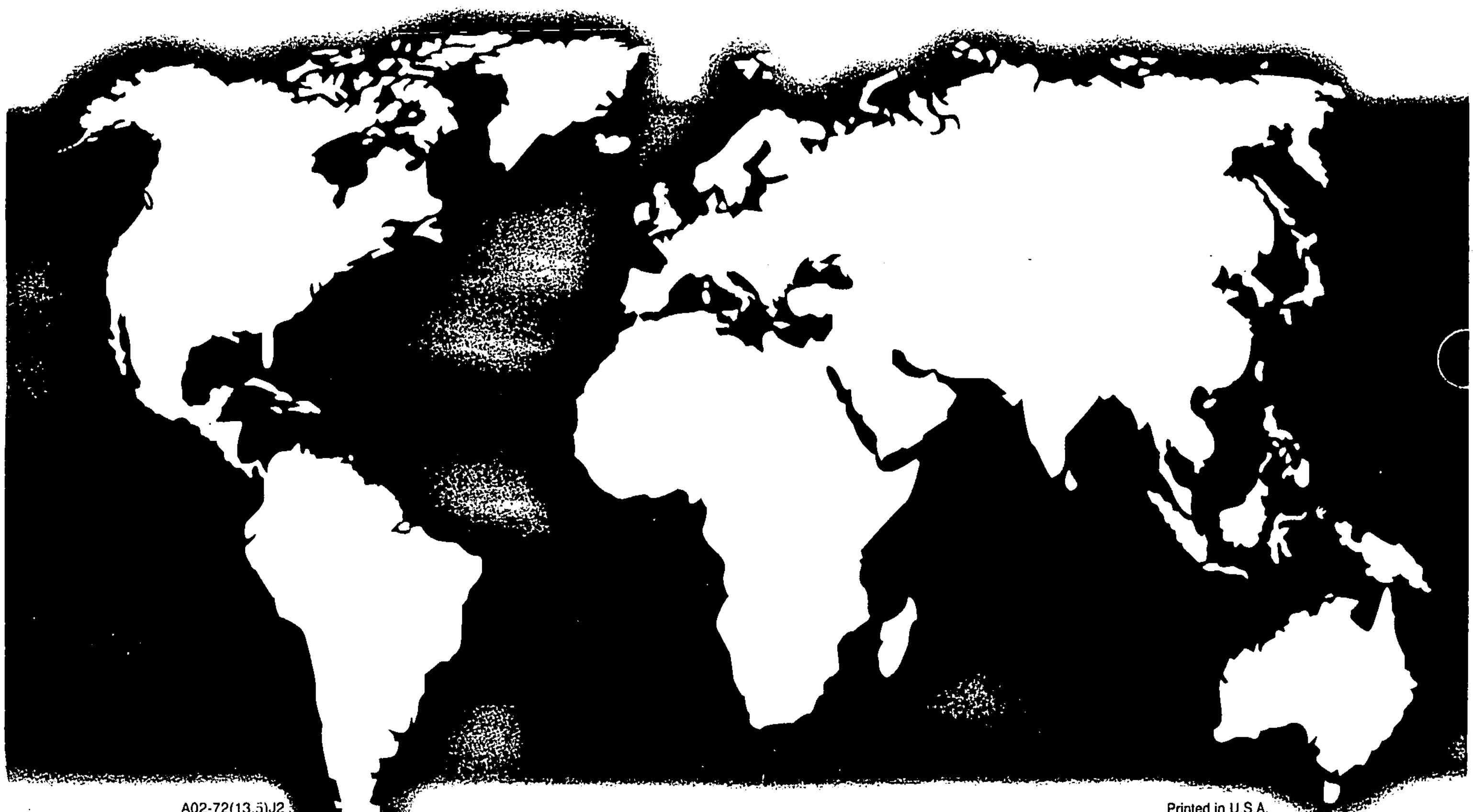

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